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Chemotaxonomic study of three Artemisia species growing in Sinai, Egypt

by

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ABSTRACT

A comparative chemotaxonomic study of three Artemisia species, A. monosperma, A. judaica and A. herba alba is presented. Eight forms of A. monosperma, growing in Wadi El-Arish (North Sinai) and the other two species growing in Wadi El-Sheikh and Wadi El-Talaa (Saint Catherine, South Sinai), respectively, were collected in the same growth season to eliminate the effect of ecological factors.

The chemical study comprised the preliminary phytochemical screening, investigation of total, watersoluble and acid-insoluble ash; carbohydrates; total nitrogen and amino acids; lipids; fatty acids and flavonoids. The results revealed that the eight forms of A. monosperma were greatly similar in their chemical composition. On the other hand, they differed qualitatively and quantitatively from the other two species, viz. A. herba alba and A. judaica. Therefore, the phytochemical results fully justified the systematic treatment.

INTRODUCTION

The genus Artemisia is of common use in folk medicine and in pharmaceutical preparations (BOULOS, 1983), and several compounds were isolated from its tissues. Most of these compounds are of medicinal interest. In this regard FAHMY et al. (1960) isolated four crystalline compounds from powdered leaves and flowering tops of A. monosperma. MAKSUDOV et al. (1962) determined the essential oils, organic acids, tannins, sugars, ash and tars in blooms of A.



Many authors identified and isolated a great number of flavone compounds from different Artemisia species: RODRI-GUEZ et al. (1972) from seven Artemisia taxa; SEGAL et al. (1973) from A. herba alba; KHAFAGY et al. (1979) from A. monosperma; GHAZOULY et al. (1984) and BACHA (1984) from A. judaica and SALEH et al. (1985) from A. monosperma and A. herba alba, SAYED et al. (1979) studied the fatty acids of A. absinthium, while LAIVANT and PROSKURNIKOVA (1965) studied the amino acids of the proteins of A. rhodantha, qualitatively, quantitatively, and their seasonal fluctuations during the developmental phases. GARRONE et al. (1973) examined the levels of free amino acids in A. vulgaris and A. verlotorum. Also, KHAMDMOV and CHAMSRKOV

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(1976) studied qualitatively the amino acids in A. diffusa, A. halophila and A. turanica. HAMMOUDA et al. (1978) isolated an acetophenone derivative and coumarins from A. monosperma.

ALEKSEEVA (1962) studied the metabolism of carbohydrates in A. turanica in various soils under desert conditions. MAKI (1968) isolated hemicellulose from leaves of A. capillaris. On the other hand, GARRONE et al. (1973) examined the levels of soluble carbohydrates in A. vulgaris and A. verlotorum.

A critical taxonomical revision was realized by GAZARA (1987) for Artemisia species growing in Sinai and known earlier by TACKHOLM (1974). In this revision, it was possible to distinguish between different Artemisia species according to vegetative, head as well as floral characters. The following key was made by GAZARA (1987).

1.a Heads homogamous, oblong, tapering at base A. herba alba

2.a Involucral bracts hairy, bisexual flowers fertile, 15-29 per head A. judaica

2.b Involucral bracts glabrous, bisexual flowers sterile, 3-9 per head

3. Heads ovate, 4 mm long, female flowers 2-6 per head

In the present study a chemotaxonomical investigation was carried out to compare the three Artemisia species, namely A. monosperma, A. judaica and A. herba alba, and

between	the	eight	different	forms	of	the	first	species.	

MATERIAL AND METHODS

The material used in the present investigation was obtained from A. judaica, A. herba alba and A. monosperma growing naturally in Sinai. The two first species were collected from South Sinai (Saint Catherine area). A. judaica was collected from Wadi El-Sheikh and A. herba alba from Wadi El-Talaa. The eigth different forms of A. monosperma (A1 - A8) were collected from Wadi El Arish, North Sinai. The plant samples of the three species were collected at the same grwoth season. The shoots were manually cleaned, dried in an oven at 50 C and reduced to fine pow-

der.

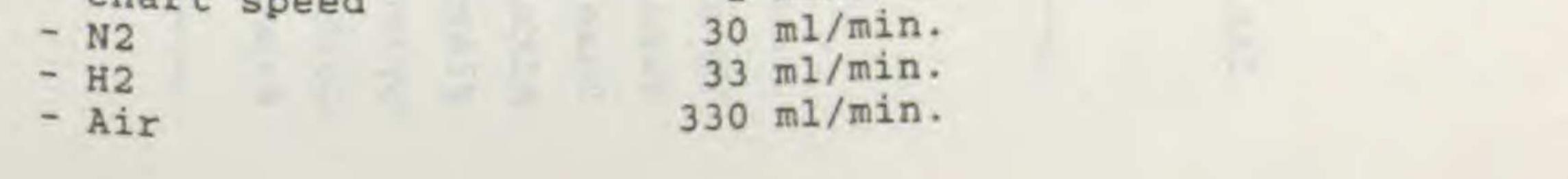
The preliminary phytocehmical screening was carried out on the powdered dried shoots of the three different species of Artemisia. This included testing for volatile oils (BAL-BAA et al. 1981), tannins (A.O.A.C., 1975), unsaturated sterols (BRIESKORN et al. 1961), flavonoids (WALL et al. 1954 and BALBAA et al. 1981), glycosides and/or carbohydrates (VOGEL 1978), and saponins (WALL et al. 1954 and ABD EL MAKSOUD 1983).

The total ash, water-soluble ash as well as acid-insoluble ash were determined according to A.O.A.C. (1975) methodology, using two grams of the powdered air-dried shoots of the eight different of A. monosperma (A1 - A8), as well as A. judaica and A. herba alba.

The total carbohadrates were determined according to the A.O.A.C. (1975) method, and the sugar content was expressed as gram dextrose generally glucose per 100 gram dry weight. The qualitative investigation of the free and combined sugars was realized according to A.O.A.A. (1975) methods of analysis.

The total nitrogen content was determined by the microkjeldhal method (ALLEN et al. 1974). Amino acids and lipid contents were investigated according to ALLEN et al. (1974). Flavonoids were investigated according to A.O.A.C. (1975) and Bacha (1984) methodology. Finally, fatty acids were studied using gas - liquid chromatography according to A.O.A.C. (1975) methodology. The analysis was done by GCV chromatograph using the following conditions:

-	Column	10 % PEGA	1
-	Column temp.	70 C (initial temp.	1
	Rate	8 C/min.	
	Final temp.	190 C	
-	Final time	20 min.	
	Chart enond	2 min./cm.	



Test

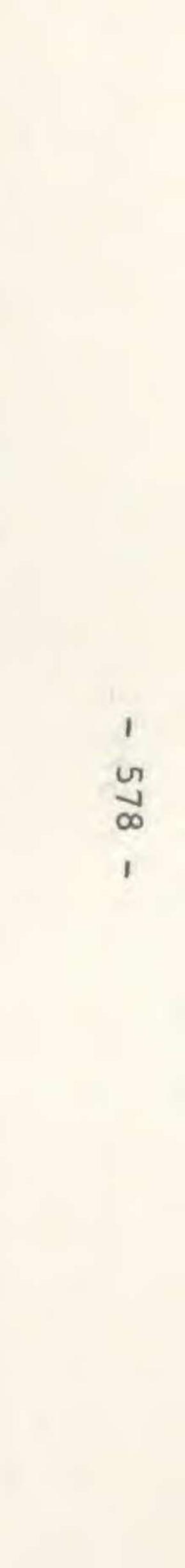
Volatil oils Tannins Unsaturated sterols Alkaloids Flavonoids Gylcosides and/or Carbohydrates Saponins

Table (1): Preliminary phytochemical screening of shoots of thress species of Artemisia

species A. monosperma A. judaica (A1-A8) + ve + ve - ve ve + ve + ve - ve - ve + ve

A. herba alba

2			+	ve	
9			-	ve	
2			+	ve	
2			-	ve	
2			+	ve	
2			+	ve	
2			+	ve	
2			+	ve	



RESULTS AND DISCUSSION

Investigation of plant constituents:

The principal chemical constituents were studies in order to compare between the eight forms of A. monosperma on one hand and between the three Artemisia species on the other hand. It can be concluded from Table (1) that all the three species of Artemisia contained volatile oils, carbohydrates and/or glycosides, flavonoids, sterols and saponins. Negative results were obtained for tannins and alkaloids in all of them.

Results presented in Table (2), revealed that the percentages of total ash content were approximately similar in different forms of A. monosperma ranging between 7.5 and 8.0 g.%. On the other hand the percentages were 7.5. and 5.5 g.% in A. judaica and A. herba alba respectively. It is clear also that water-soluble ash content in A. monosperma were approximately similar in different forms ranging between 3.5 and 4.0 g.%. Obviously, the records were 4.0 and 2.5 g.% in A. judaica and A. herba alba respectively. Results also clarified that the acid-insoluble content of different forms of A. monosperma ranged between 0.5 and 1.0 g.%. A. judaica and A. herba alba on the other hand had higher values of 2.8 and 2.3 g.% respectively (Table 2).

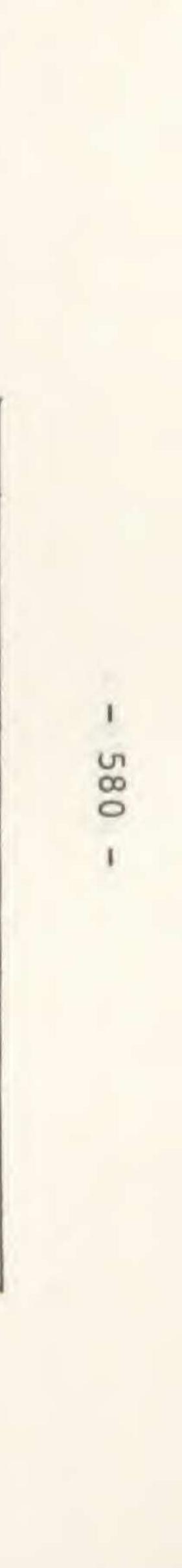
had It is clear that the eight forms of A. monosperma similar contents of total ash as well as water-soluble and acid-insoluble ash content. These contents differed from those ot the other two Artemisia species. Although the total ash and water-soluble ash of A. judaica were similar to those of A. monospermam the acid-insoluble ash was much higher. The contents of the three types of ash in A. herba alba differed from those of the other two species.

Results presented in Table (2) clearly show that the total carbohydrate contents of the studied Artemisia species belonging to A. monosperma (A1 - A8) attained values that ranged between 0.83 and 0.879/100 g. dry matter. On the other hand, data collected for A. judaica and A. herba alba indicated higher values (2.42 & 2.60) g.% respectively).

The qualitative study of sugars presents in the three studied species using paper chromatography (Table 3) revealed that A. monosperma with all different forms contained galactose. The other two species, namely A. judaica and A. herba alba contained mannose. All the forms of A. monosperma differed from the other two Artemisia species.

Species		A.	monosper	ma					A.ju- daica	A.herba alba	
Characters	A	A ₂	A ₃	A ₄	A5	A ₆	A7	A ₈			
Total Ash (g.%)	7.5	7.5	7.5	8.0	7.5	8.0	8.0	7.5	7.5	5.5	
Water Soluble Ash (g.%)	4.0	4.0	3.5	4.0	4.0	4.0	4.0	4.0	4.0	2.5	
Acid - Insoluble Ash (g.%)	0.5	1.0	1.0	0.5	0.5	1.0	1.0	0.5	2.8	2.3	
Total Carbohydrates as g.% glucose	0.87	0.83	0.83	0.83	0.87	0.87	0.87	0.83	2.42	2.60	
Total Nitrogen content g./100g. plant material	0.286	0.276	0.286	0.286	0.286	0.276	0.276	0.276	0.332	0.350	
Percentage of alcoholic extract (crude flavones)	3.28	3.31	3.37	3.24	3.28	3.28	3.37	3.28	0.50	0.40	
Total Lipid content g.%	15.4	15.4	14.2	15.4	14.2	15.4	14.2	14.2	10.2	8.2	

Table (2) A: Quantitative Analysis of the three Artemisia species



Results in Table (2) also show that the amounts of the total nitrogen content attained their maximum values in A. *judaica* (0.332 g%) and A. *herba alba* (0.350 g.%) that decreased remarkably in the eight forms of A. monosperma (0.276-0.286 g.%).

The results of total lipid content (Table 2) estimated quantitatively in the different forms of A. monosperma (A1 - A8) indicated values that ranged between 14.2 to 15.4 g.%. On the other hand, both A. judaica and A. herba alba indicated lower values of 10.2 and 8.2 g.% respectively.

The percentages of the alcoholic extract, containing total flavones, were also compared (Table 2). It is evident that the crude total flavonoid content of the eight forms of A. monosperma were similar, ranging from 3.24 to 3.31 g.%; however A. judaica contained only 0.5 g.%; nevertheless A. herba alba contained the least amount of flavonoids (0.14 g.%).

The results of the qualitative study of amino acids in the three studied species using paper chromatography (Table 3) revealed that A. monosperma with all its different forms contained lysine, asparagin, aspartic acid, glutamic acid, alanine, tyrosine, methionine and leucine. On the other hand, A. judaica contained lysine, aspartic acid, glutamic acid, alanine, tyrosine, valine, and leucine; while A. herba alba contained cystine, lysine, asparagin, serine, alanine, valine and isoleucine.

Considering the qualitative investigation of flavonoids (Table 3) A. monosperma contained quercetin 3-glucoside, quercetin 3-rutinoside, quercetin 5-glucoside, insorhamnetin 5-glucoside, patuletin 3-rutinoside, acacetin 7-glucoside, acacetin 7-rutinoside, vicenin -2, lucenin and methylated aglycones as reported by SALEH et al. (1985). Differently, A. judaica contained chrysoerial 7-rutinoside, leutulin, cirstakogenin (BACHA 1984). Finally, A. herba alba contained quercetin 3-glucoside, quercetin 3-rutinoside, patuletin 3-glucoside, patuletin 3-rutinoside, isovitexin, vicenin -2 schaftoside, isoschaftoside and methylated aglycones (SALEH et al. 1985). These results clarify the presence of different flavones in the three Artemisia species. The results also show that the eight forms of A. monosperma contain the same flavones, and differ from the other two species.

The resulty presented in Table (4) reveal the presence of the following fatty acids in the eight forms of A. monosperma: octanoic, capric, lauric, tridecanoid, myristic, pentadecanoic, palmitic, stearic, oleic, linoleic, linolenic and arachidic acids. It is also clear that A. judaica contained a group of fatty acids similar to that of A. mo-

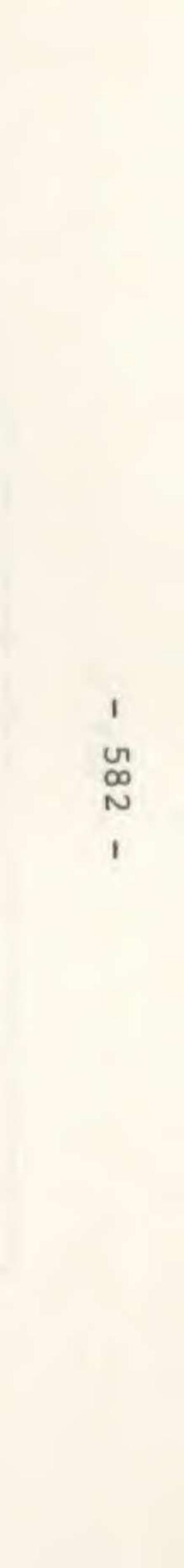
contained a group of fatty acids similar nosperma, with the difference that und sent, while octanoic and arachidic aci	decanoic actu in pr
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Species				A. 1	nonospe	erma			A. judaica	A.herba-alba
Characters	A1	A2	A ₃	A4	A ₅	A ₆	A7	A ₈		
Carbohydrates										
Galactose	+	+	+	+	+	+	+	+		-
Mannose	-	-	-	-	-	-	-	-	+	+
Amino acids										
Cystine	-	-	-	-	-	-	-	-	+	+
Lysine	+	+	+	+	+	+	+	+	+	+
Aspargine	+	+	+	+	+	+	+	+	-	+
Aspartic acid	+	+	+	+	+	+	+	+	+	-
Glutamic acid	+	+	+	+	+	+	+	+	+	-
Serine	-	-	-	-	-	-	-	-	_	+
Alanine	+	.+	+	+	+	+	+	+	+	+
Tyrosine	+	+	+	+	+	+	+	+	+	-
Methionine	+	+	+	+	+	+	+	+	-	
Valine	-	-	-	-	-	-	-	-	+	+
Leucine	+	+	+	4	+	+	+	+	+	-
Isoleucine	-	-	-	-	-	-	-	-	-	+
Flavonoids	1.00.00									
Quercetin 3-glucoside	+	+	+	+	+	+	+	+	_	+
Quercetin 3-rutinoside	+	+	+	+	+	+	+	+	-	+
Quercetin 5-glucoside		+	+	+	+	+	+	+		+
Isorhamnetin 5-glucoside				+		+		+		
Patuletin 3-glucoside								-		
Paluletin 3-rutinoside		-			-					
Acacetin 7-glucoside				*			*			
Acacetin 7-rutinoside						-	-	-		-
	T	Ŧ		*	*		*	*		
Isovitexin	+	*	*	*	+	*	+	+		-
Vicenin - 2	+		*	+		+	+	*		1
Schaftoside	-	-	-			-	-	-		-
Isoschaftoside	-	-	-	-	-	-	-	-		+
Lucenin - 2	+	+	+	+	+	+	+	*		
Methyaglycone	+	+	+	+	+	+	+	+		+
Chrysoerial 7-rutinoside	-	-	-	-	-	-	-	-	+	
Leutulin	-	-	-	-	-	-	-	-	+	-
Cirstakogenin	-	-		-	-	-	-		+	
Apigenin	-		-	-	-	-	-		+	-

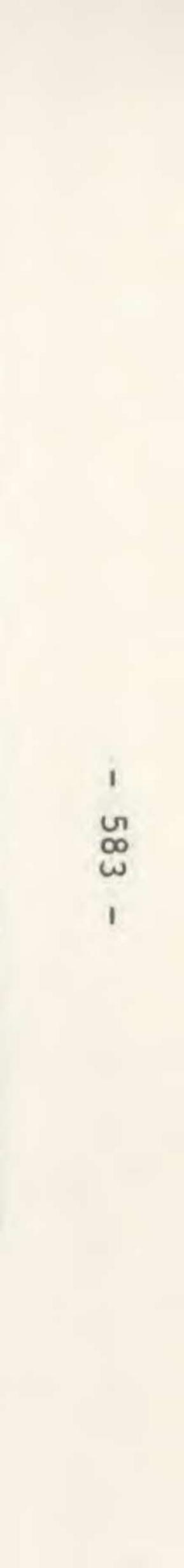
* Identified by BACHA (1984) & SALEH et al. (1985).

Table (3): Qualitative analysis of Carbohydrates, amino-acids, flaronoids and fatty acids of the three Artemisia species



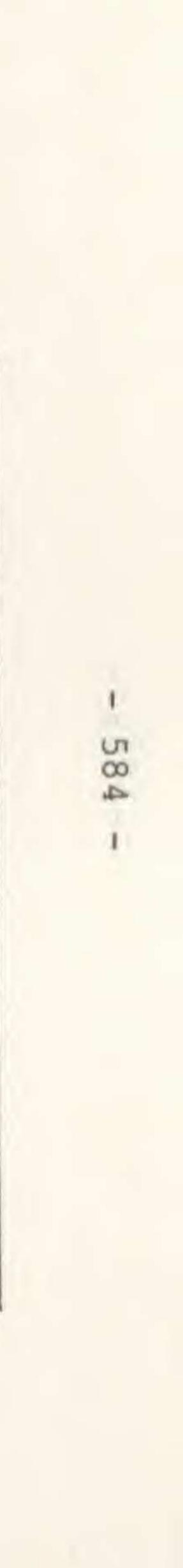
Qualitative analysis (Cont.) Table (3)

Species Characters			Α.	mono	sperm	a			A. judaica	A.herba-alba
	A1	A2	A ₃	A4	A ₅	A ₆	A7	A ₈		
Fatty acid esters										
Octanoic										
Octanoic	+	+	+	+	+	+	+	+	+	-
Capric	+	+	+	+	+	+	+	+	+	+
Undecanoic	-	-	-	-	-	-	-	-	-	-
Lauric	+	+	+	+	+	+	+	+	+	+
Tridecanoic	+	+	+	+	+	+	+	+	+	+
Myristic	+	+	+	+	+	+	+	+	+	+
Pentadecanoic	+	+	+	+	+	+	+	+	+	+
Palmitic	+	+	+	+	+	+	+	+	+	+
Stearic	+	+	+	+	+	+	+	+	+	+
Oleic	+	+	+	+	+	+	+	+	+	+
Linoleic	+	+	+	+	+	+	+	+	+	+
Linolemic	+	+	+	+	+	+	+	+	-	+
Arachidic	+	+	+	+	+	+	+	+	-	-



Fatty acid				1. 110100	ospermo	4			A. judaica	A. herba-alba
	A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	A7	A ₈	A. Judated	A. nerva acou
Octanoic	5.84	0.82	9.09	22.57	5.75	6.85	4.59	0.82		25.87
Capric	26.16	9.33	12.12	4.27	16.09	21.27	25.22	9.33	24.31	7.71
Undecanoic	-	-	-	-	-	-	-	-	2.78	-
Lauric	1.11	0.27	0.22	1.65	0.81	2.95	0.33	0.27	8.10	8.81
Tridecanoic	0.47	1.51	2.98	5.37	2.01	5.32	3.49	1.51	2.31	12.11
Myristic	3.96	0.96	1.5	2.20	2.76	11.82	2.18	0.96	3.86	5.50
Pentadecanoic	4.42	16.58	9.20	34.17	9.58	14.65	4.80	16.58	27.39	4.41
Palmitic	50.49	15.79	17.86	11.3	21.86	24.82	16.38	15.79	1.93	2.75
Stearic	0.32	1.57	2.71	1.65	1.53	0.83	0.76	1.57	3.70	1.47
Oleic	0.26	9.02	8.44	3.05	7.66	0.59	15.07	9.02	4.63	17.61
Linoleic	3.47	36.84	18.99	8.79	25.21	0.89	16.81	36.84	7.41	13.76
Linolemic	2.24	5.26	12.99	3.67	3.58	2.92	8.73	5.26	13.58	-
Arachidic	1.26	2.05	3.90	1.22	3.16	7.09	1.64	2.05	-	

Table (4): Percentages of fatty acid esters of the three studied Artemisia species



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other hand A. herba alba contained octanoic, capric, lauric, tridecanoic, stearic, oleic, linoleic, acids, and was free of undecanoic, lineolenic and arachidic acids. These results show that the percentage of some fatty acids varies not only in the three Artemisia species, but also in the forms of A. monosperma (Table 4). It must be noted that the qualitative estimation of fatty acids esters by Gas Liquid Chromotography is strict since it depends on comparing the fatty acids by authentic samples. On the other hand, the quantitative estimation of some fatty acids by the same method may differ sinde the peak shape differs in operating conditions and injection technique.

It can be concluded that the eight forms of A. mono-

sperma contain the same fatty acids, which differ from those of the other two species viz. A. judaica and A. herba alba.

From these results, it is clear that the eight forms of A. monosperma are greatly similar in their chemical composition. They differ qualitatively and quantitatively from the other two species, viz. A. judaica and A. herba alba. In this regard, the phytochemical study fully justifies the systematic treatment.

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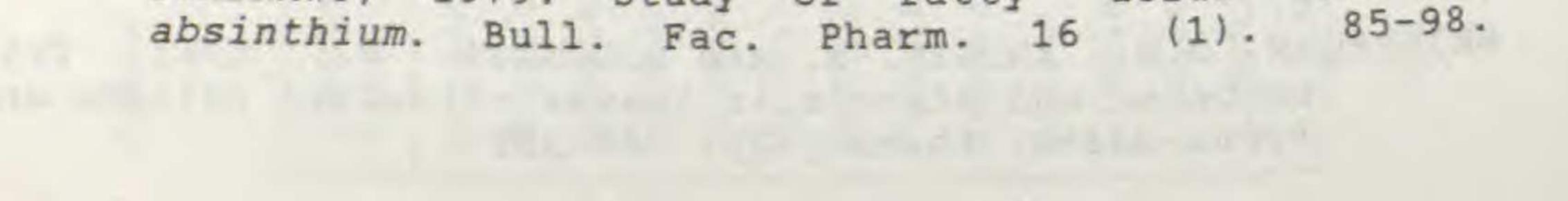
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